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Preface

Special issue on mercury in Canada's North

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Although mercury is a natural element, human activities—particularly the widespread combustion of coal—have released large quantities of mercury into the atmosphere and increased levels of mercury deposition around the globe. Air currents transport mercury over long distances and thereby connect emission sources at lower latitudes to the Arctic. The increase in anthropogenic mercury emissions due to industrialization over the last century and the transport of these emissions northward via air currents have resulted in levels of mercury in the Arctic environment that are significantly above historical levels (Dietz et al., 2009; Fitzgerald et al., 2005; Muir et al., 2009; Outridge et al., 2009). This trend in mercury levels continues in some biota and areas of the Arctic despite recognition of the issue and actions by many countries to mitigate mercury releases (Rigét et al., 2011).

For over two decades, the Government of Canada has implemented the Northern Contaminants Program (NCP), currently administered through Aboriginal Affairs and Northern Development Canada, to support research and monitoring of contaminants (including mercury) in the Canadian Arctic. This program was established in 1991 in response to concerns about human exposure to elevated levels of contaminants in fish and wildlife species important to the traditional diets of Arctic Aboriginal peoples.

The NCP addresses the issue of Arctic mercury pollution by: 1) monitoring mercury levels in Arctic biota that are most relevant to human contaminant exposure while also fulfilling Canada's monitoring obligations under international agreements; 2) conducting research on mercury cycling in the Arctic environment and its effects on Arctic biota; 3) monitoring and research on human health effects; 4) promoting education and communication efforts to enable the provision of sound advice on the consumption of country foods; and 5) communicating scientific results to national and international policy makers to promote and inform regulation. Since 1991, the NCP has completed three program phases, each of which resulted in the release of a state-of-the-science report called a Canadian Arctic Contaminants Assessment Report (CACAR). Most recently, the NCP released the *CACAR III: Mercury in Canada's North 2012*, which is the first assessment report to focus exclusively on mercury pollution in the Canadian Arctic (NCP, 2012). Internationally, the NCP works very closely with the circumpolar Arctic Monitoring and Assessment Programme (AMAP), a working group of the Arctic Council that provides scientific information on contaminant issues in circumpolar countries. Preparation of the CACAR III involved collaboration with the AMAP, which concurrently produced a mercury assessment for the circumpolar Arctic (AMAP, 2011).

This special issue of *Science of the Total Environment* summarizes the extensive research that has been conducted on the transport and environmental fate of mercury in the Canadian Arctic over the last decade. It consists of a series of comprehensive review articles that synthesize the main findings of the NCP's recent assessment report on mercury and includes original research articles which examine specific topics in greater detail. The review articles are organized by environment—atmosphere, terrestrial, freshwater and marine—with mercury data presented for relevant physical and biological compartments in each environment. A review of the state of knowledge on biological effects of mercury in Arctic biota completes the series of review articles.

The original research articles which complement the reviews in this special issue address issues including current and past atmospheric mercury deposition rates using glaciers as an environmental archive, the fate of mercury deposited to snow (via photochemical reactions), bioaccumulation and biomagnification of mercury in freshwater and marine food webs, the potential neurotoxic effects of mercury in marine mammals, and human dietary exposure to mercury resulting from the consumption of fish and wildlife. While the advances in Arctic mercury science are significant, the complex nature of the mercury cycle continues to provide challenges in characterizing and quantifying the relationships of mercury sources and transport processes with mercury levels in biota and biological effects of mercury exposure.

Current levels of mercury found in Arctic ecosystems are a legacy of anthropogenic emissions that began with the onset of the Industrial Era. With continued global economic development dependent on the combustion of coal, it is predicted that mercury deposition to the Arctic will continue to rise (see Dastoor et al., 2015–in this issue), particularly if emissions are left unchecked. Arctic contaminant science has had a major influence on global agreements to reduce emissions, including the Stockholm Convention on Persistent Organic Pollutants and now the Minamata Convention on Mercury. Both of these global agreements include provisions for ongoing research and monitoring that make specific mention of remote regions like the Arctic as sentinels for the impacts of global pollution. In order to better support these global actions on a national and international level, and manage current mercury-related risks, continued research and monitoring are essential to further our understanding of mercury in the Canadian Arctic. As the North undergoes widespread environmental change and human activities expand throughout the region, new challenges are emerging in Arctic mercury science that will need to be addressed.

References

AMAP. AMAP Assessment 2011: Mercury in the Arctic. Oslo, Norway: Arctic Monitoring and Assessment Programme (AMAP); 2011 [pp. xiv + 193].

Dastoor A, Ryzhkov A, Durnford D, Lehnherr I, Steffen A, Morisson H. Atmospheric mercury in the Canadian Arctic. Part II: Insights from modeling. Sci Total Environ 2015;209–210:1–2. [in this issue].

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Dietz R, Outridge PM, Hobson KA. Anthropogenic contributions to mercury levels in present-day Arctic animals — A review. Sci Total Environ 2009;407:6120–31.
Fitzgerald WF, Engstrom DR, Lamborg CH, Tseng C-M, Balcom PH, Hammerschmidt CR. Modern and historic atmospheric mercury fluxes in northern Alaska: Global sources and Arctic depletion. Environ Sci Technol 2005;39:557–68.
Muir DCG, Wang X, Yang F, Nguyen N, Jackson TA, Evans MS, et al. Spatial trends and historical deposition of mercury in eastern and northern Canada inferred from lake sediment cores. Environ Sci Technol 2009;43:4802–9.
NCP. Canadian Arctic Contaminants Assessment Report III: Mercury in Canada's North. Canada, Ottawa: Northern Contaminants Program (NCP), Aboriginal Affairs and Northern Development; 2012 [pp. xxiii + 276].
Outridge PM, Hobson KA, Savelle J. Long-term changes of mercury levels in ringed seal (*Phoca hispida*) from Amundsen Gulf, and beluga (*Delphinapterus leucas*) from the Beaufort Sea, western Canadian Arctic. Sci Total Environ 2009;407:6044–51.
Rigét F, Braune B, Bignert A, Wilson S, Aars J, Born E, et al. Temporal trends of Hg in Arctic biota, an update. Sci Total Environ 2011;409:3520–6.

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